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SANITATION OF FROZEN FOODS

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For practical purposes sanitation may be defined as cleanliness or the absence of foreign matter, including micro-organisms, in a food-processing plant or its product. The fact that foreign matter in a foodstuff may not be injurious to health does not excuse its presence; thus jam or ketchup containing dead mold fragments or yeast cells is considered by regulatory authorities as adulterated food, of poor sanitary history. The same applies to a food containing insects or insect parts, or animal excreta. It should be noted too, that an unsanitary food-processing plant can be condemned though proof of contamination of its product is lacking. Furthermore, modern sanitary codes are concerned with such factors as lighting, ventilation, and lavatory facilities, which have an important bearing on the health and comfort of employees, and take cognizance of such nuisances as improper disposal of plant waste. The field of sanitation is therefore, a wide one, and particular industries have their own special sanitary problems. Though the importance of other factors is recognized, attention in this article is centered on the considerations involved in the production of frozen fruits and vegetables of reasonably low microbial content.

At the outset it probably is not amiss to state a few fundamental facts about micro-organisms in order that succeeding paragraphs may be more readily understood. A single bacterial cell is so small that it can be seen only under the microscope. Roughly speaking, from 5,000 to 10,000 red-shaped bacteria placed end to end would measure only one inch, while about 20,000 of the round type would be required to stretch an equal distance. Bacteria are so widespread that a few hundred or even several thousand on a sample of fresh food may be considered normal, and would be of no moment were it not for the amazing ability of bacteria to increase. Under favorable conditions a bacterial cell will divide to form two cells in 20 minutes, and in the course of 24 hours will give rise to a colony easily seen by the naked eye. For example, the slimy material on delayed peas consists of enormous numbers of bacterial cells which are decended from the relatively small number originally present on the fresh material. At this point the peas are naturally unfit for food. Apart from the presence of the bacteria, which are rightly to be regarded as foreign matter, profound chemical changes have taken place. In their demand for food and energy the bacteria have attacked and altered the normal constituents of the pea; thus, part of the sugar has been changed to lactic acid, which in turn alters the chlorophyll or green coloring matter to a yellowish compound. All packers have noticed this souring and loss of green color, which are sure signs of bacterial action, in samples that have been accidentally mishandled, or in waste material. The deterioration may take place anywhere, between harvest field and plant, in the plant itself, or during transport, and may vary all the way from incipient fermentation, which creates difficult borderline cases, to outright spoilage. Fortunately, a great deal can be

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done to slow the rate of bacterial growth by lowering the temperature. Bacteria are sensitive to temperature changes and the statement that "cold preserves" is a handy way of saying that the ability of bacteria to grow and alter foodstuffs becomes less as temperature falls. At from 70° to 100° F. the germs of concern to the packer multiply rapidly; at 60° F. growth is appreciably slowed; and at 40° F. it is figuratively "thrown into low gear". (Figs. 1 and 2). At 32° F. many kinds of bacteria fail to grow, and at about 15° F. all types of micro-organisms apparently are not merely suppressed but tend to die out.

The packer, especially in these days of long hauls, must therefore turn practical bacteriologist and guard the quality of his raw produce by the handiest and best means at his disposal; namely, cold. If he is a good packer he will not lull himself into a false security by believing that, since many of the bacteria will be removed or killed by washing or scalding in the plant, he can afford to be careless. Instead, he knows that valuable constituents are consumed by bacteria, that compounds foreign to the product are formed, and that these defects cannot be remedied by any system of preservation, least of all by freezing.

What has just been said refers specifically to bacteria. The packer has to contend with two other classes of micro-organisms, namely, yeasts and molds. These are very active in the spoilage of fruits and berries because, unlike bacteria, they can thrive under acid conditions. However, what has been indicated regarding the widespread distribution of bacteria, the rapidity and undesirability of their growth, and their reaction to temperature, applies in a general way to yeasts and molds.

The fact is not being lost sight of that under the proper conditions, molds, yeasts, and bacteria are useful in the cheese-making, wine and pickling industries. However, frozen-food packers are interested in supplying the public with produce in as nearly the fresh state as possible; it is, therefore, their duty to see that their products contain no more micro-organisms than are unavoidable under sanitary operating conditions.

The question of assuring low bacterial counts in frozen foods is not only confined to care of the raw material between field and plant. Much contamination can, and too often does, take place in the plant itself, and much of it is avoidable. The fact that succulent material like peas and strawberries come to harbor great numbers of germs in a few hours at plant temperatures cannot be changed; it is, however, possible and necessary that particles of foodstuffs be prevented from accumulating and adding to the microbial content of material passing over the line. Sorting belts are particularly likely to prove troublesome because they are always moist, and since their surfaces are not smooth, they permit entrapment of small particles of material which soon ferment. Studies have often shown a significant increase in bacterial numbers in the short time the produce is on the belt; counts on peas rise from 150,000 per gram, which is reasonably low, to 500,000 per gram, which is rather excessive.

Methods of line cleaning vary from plant to plant, but they must fulfill two basic conditions to be effective; namely, they must be frequently applied, and they must make provision for the free use of steam or hot water and scrubbing brush. These time-honored aids are so effective in the killing of micro-organisms and removal of debris that they cannot be neglected. Chemical sterilization is easiest

when most of the organic matter has been mechanically removed. In choosing a chemical the operator should satisfy himself on several points. First, it should have the power to kill germs; second, it should be non-toxic to human beings in the dilution used, and third, it should impart no taint to the food. Some other considerations such as ease of application, lack of corrosiveness to metal, cost, and availability will present themselves. The search for harmless germicides is steadily going forward, and no doubt the list to choose from will be longer in the next few years. Common sense will make it clear to the packer that the water he uses, in addition to being chemically suitable, must be beyond reproach in the bacteriological sense; also that waste produce, which will give off bad odors and in addition become a focus of infection, must be promptly removed.

In the case of precooked frozen foods, the problems do not lie in the nature of the ingredients likely to be used -- indeed, many of the individual items are already frozen successfully -- but in the method of preparation, which consists of thorough cooking, with consequent destruction of the less heat-resistant bacteria. From the theoretical viewpoint, therefore, precooked frozen foods bear a resemblance, bacteriologically speaking, to under-processed canned goods, which not only fail to "keep", but constitute a public-health hazard. It is probable, however, that under practical conditions the frozen foods are reinoculated with harmless spoilage bacteria. Furthermore, under proper low-temperature storage and distribution, they will reach the consumer in wholesome condition. The question narrows down to whether, under improper handling by a careless chef or housewife, the spoilage of precooked frozen foods may not be of the dangerous type. So far, no difficulty appears to have been encountered. It is to be hoped that in regard to this matter, which is sanitation in the older and stricter meaning of the term, research will play its traditional part in frozen food development, keeping abreast of, or better still ahead of, commercial exploitation in the promising of field of precooked frozen foods, now opening up.

It is fully realized that any cataloging of things to do, in order to keep microbial counts low in frozen foods, must be general in nature. Every plant has its own particular problems. However, the following points, selected on the basis of considerable work in the frozen pack field, are offered as worthy of consideration:

1. A determined and sustained effort should be made to keep viners clean; otherwise peas and lima beans start with the serious handicap of heavy bacterial contamination.

2. Efficient means, adequate for peak loads, for cooling produce immediately after harvest to within the temperature zone 35° -- 45° F. should be provided.

3. Rise in temperature between field or precooling station and plant should be prevented by icing or other means.

4. Produce should not be held longer than two hours at 80° F., five hours at 60° F., or 24 hours at 40° F. The temperatures given refer to the produce itself, not merely to the surrounding atmosphere; also the full times stated should be avoided rather than taken advantage of.

5. Bacteria should not be harbored on the line and in the plant generally, which means that waste produce must not be allowed to collect. Sorting belts are

often the greatest single cause of bacterial "build-ups", and accordingly demand special sanitary attention.

6. Workers should wear clean clothing and be cleanly in their personal habits. Well-appointed and convenient washrooms are a feature of every up-to-date food-handling plant.

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